**STATE UNIVERSITY OF NEW YORK !**
**COLLEGE OF TECHNOLOGY !**
**CANTON, NEW YORK !**


# MASTER SYLLABUS

## COURSE NUMBER – COURSE NAME
## PHYS 340 – ELECTROMAGNETISM

**Created by: Dr. Lawretta Ononye**

**Updated by: Dr. Lawretta Ononye**

**Canino School of Engineering Technology !**

**Department: Physics !**

**Semester/Year: Fall 2018 !**

**A.** **TITLE**: Electromagnetism

**B.** **COURSE NUMBER:** PHYS 340

**C.** **CREDIT HOURS: (Hours of Lecture, Laboratory, Recitation, Tutorial, Activity)**

**# Credit Hours:** 3
**# Lecture Hours:** 3 **per week**
**# Lab Hours:** **per week**
**Other:** **per week**

**Course Length:** 15 **Weeks**

**D.** **WRITING INTENSIVE COURSE**: Yes ☐ No ☒

**E.** **GER CATEGORY: None:** ☒ **Yes:** GER !
***If course satisfies more than one*:** GER !

**F.** **SEMESTER(S) OFFERED: Fall** ☐ **Spring** ☐ **Fall & Spring** ☒

**G.** **COURSE DESCRIPTION:**

This course is an intermediate level presentation of the physics of the electromagnetic field. The course will explore the applications of electromagnetism in medicine (magnetic resonance imaging), and the interdependencies between electric and magnetic fields which are the essence of the theories of circuits, lines, antennas and guided waves. Topics include Electric and magnetic fields using vector methods, Gauss's law, theory of dielectrics, Ampere's law, Faraday's law, vector potential, displacement current, Maxwell's equations, wave propagation in dielectrics and conductors, and production and propagation of radiation.

**H.** **PRE-REQUISITES: None** ☐ **Yes** ☒ **If yes, list below:**

University Physics II or College Physics II; Calculus II; or permission of the instructor.

**CO-REQUISITES: None** ☒ **Yes** ☐ **If yes, list below:**

## I. STUDENT LEARNING OUTCOMES: (*see key below*)

By the end of this course, the student will be able to:

| ***Course Student Learning Outcome [SLO]*** | ***Program Student Learning Outcome [PSLO]*** | ***GER*** *[If Applicable]* | ***ISLO & SUBSETS*** | |
|---|---|---|---|---|
| a. State the laws of electromagnetism, examine the sources of electromagnetic radiation and relate its importance in terms of practical applications. | | | 2-Crit Think<br>ISLO<br>ISLO | CA<br>Subsets<br>Subsets<br>Subsets |
| b. Integrate how the interdependencies between electric and magnetic fields are the essence of the theories of circuits, lines, antennas, propagation, and guided waves. | | | 2-Crit Think<br>ISLO<br>ISLO | CA<br>Subsets<br>Subsets<br>Subsets |
| c. Examine the reflection and refraction of waves at boundaries; and the scattering of waves by free and bound electrons. | | | 2-Crit Think<br>ISLO<br>ISLO | CA<br>Subsets<br>Subsets<br>Subsets |
| d. Analyze how accelerated charges produce electromagnetic radiation. | | | 2-Crit Think<br>ISLO<br>ISLO | CA<br>Subsets<br>Subsets<br>Subsets |
| e. Apply Maxwell's equations to describe the propagation of electromagnetic waves in vacuum. | | | 2-Crit Think<br>ISLO<br>ISLO | CA<br>Subsets<br>Subsets<br>Subsets |

| **KEY** | **Institutional Student Learning Outcomes [ISLO 1 – 5]** |
|---|---|
| **ISLO #** | **ISLO & Subsets** |
| **1** | **Communication Skills**<br>Oral [O], Written [W] |
| **2** | **Critical Thinking**<br>*Critical Analysis [CA] , Inquiry & Analysis [IA] , Problem Solving [PS]* |
| **3** | **Foundational Skills**<br>*Information Management [IM], Quantitative Lit,/Reasoning [QTR]* |
| **4** | **Social Responsibility**<br>*Ethical Reasoning [ER], Global Learning [GL], Intercultural Knowledge [IK], Teamwork [T]* |
| **5** | **Industry, Professional, Discipline Specific Knowledge and Skills** |

*Include program objectives if applicable. Please consult with Program Coordinator !

**J. APPLIED LEARNING COMPONENT:** Yes ☒ No ☐

If YES, select one or more of the following categories:

- ☒ Classroom/Lab
- ☐ Internship
- ☐ Clinical Placement
- ☐ Practicum
- ☐ Service Learning
- ☐ Community Service
- ☐ Civic Engagement
- ☐ Creative Works/Senior Project
- ☐ Research
- ☐ Entrepreneurship (program, class, project)

**K. TEXTS:**

Griffiths, David (1999). Introduction to Electrodynamics. Prentice Hall

**L. REFERENCES:**

None

**M. EQUIPMENT: None** ☐ **Needed:** Technology enhanced classroom

**N. GRADING METHOD:** A-F

**O. SUGGESTED MEASUREMENT CRITERIA/METHODS:**

**• Exams • Quizzes • Homework • Participation • Project/Presentation**

**P. DETAILED COURSE OUTLINE:**

**I. Electrostatics**
**A. Introduction**
**B. Electrostatic energy**
**C. Ohm's law**
**D. Conductors**
**E. Boundary conditions on the electric field**
**F. Capacitors**
**G. Poisson's equation**
**H. The uniqueness theorem**
**I. One-dimensional solution of Poisson's equation**
**J. The method of images**
**K. Complex analysis**
**L. Separation of variables**

**II. Time-independent Maxwell equations**
**A. Introduction**
**B. Coulomb's law**
**C. The electric scalar potential**
**D. Gauss' law**
**E. Poisson's equation**

**F. Ampère's experiments**
**G. The Lorentz force**
**H. Ampère's law**
**I. Magnetic monopoles?**
**J. Ampère's circuital law**
**K. Helmholtz's theorem**
**L. The magnetic vector potential**
**M. The Biot-Savart law**
**N. Electrostatics and magnetostatics**

**III. Time-dependent Maxwell's equations**
**A. Introduction**
**B. Faraday's law**
**C. Electric scalar potential?**
**D. Gauge transformations**
**E. The displacement current**
**F. Potential formulation**
**G. Electromagnetic waves**
**H. Green's functions**
**I. Retarded potentials**
**J. Advanced potentials?**
**K. Retarded fields**

**IV. Dielectric and magnetic media**
**A. Introduction**
**B. Polarization**
**C. Boundary conditions for and E and D**
**D. Boundary value problems with dielectrics**
**E. Energy density within a dielectric medium**
**F. Magnetization**
**G. Magnetic susceptibility and permeability**
**H. Ferromagnetism**
**I. Boundary conditions for and B and H**
**J. Boundary value problems with ferromagnets**
**K. Magnetic energy**

**V. Magnetic induction**
**A. Introduction**
**B. Inductance**
**C. Self-inductance**
**D. Mutual inductance**
**E. Magnetic energy**
**F. Alternating current circuits**
**G. Transmission lines**

**VI. Electromagnetic energy and momentum**
**A. Introduction**
**B. Energy conservation**
**C. Electromagnetic momentum**
**D. Momentum conservation**

**VII. Electromagnetic radiation**
**A. Introduction**

**B. The Hertzian dipole**
**C. Electric dipole radiation**
**D. Thompson scattering**
**E. Rayleigh scattering**
**F. Propagation in a dielectric medium**
**G. Dielectric constant of a gaseous medium**
**H. Dielectric constant of a plasma**
**I. Faraday rotation**
**J. Propagation in a conductor**
**K. Dielectric constant of a collisional plasma**
**L. Reflection at a dielectric boundary**
**M. Wave-guides**

**Q. <u>LABORATORY OUTLINE</u>: None ☒ Yes ☐**

**None**